ENCE 355 – Introduction to Structural Design
SOLUTIONS to Homework Set No. 13
Fall 2002

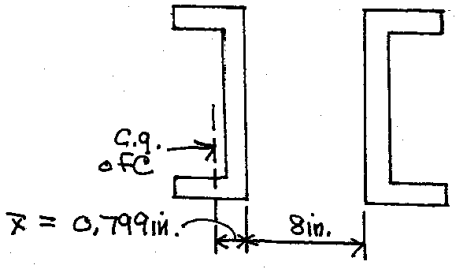
PROB # 6-22 (1)

Assume $\frac{KL}{r} = 50$

$\phi_c F_{cr} = 35.40$ ksi

A Reqd $= \frac{925}{35.40} = 26.13\ in^2$ or $13.065\ in.^2$ per C

Try 2 Cs 15 X 50 [For each channel $A = 14.7\ in.^2$,
$\bar{x} = 0.799$ in., $I_x = 404\ in.^4$, $I_y = 11.0\ in.^4$, $r_y = 0.865$ in.



$I_x = (2)(404) = 808\ in.^4$

$I_y = (2)(11) + (2)(14.7)(4.799)^2 = 699.1\ in.^4$

$r_y = \sqrt{\frac{699.1}{(2)(14.7)}} = 4.88$ in.

$\left(\frac{KL}{r}\right)_y = \frac{(1)(12 \times 24)}{4.88} = 59.02$

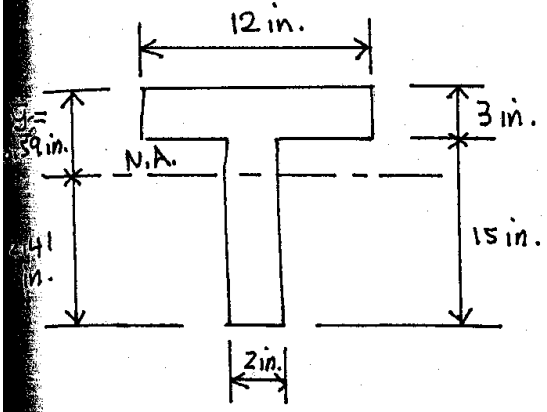
$\phi_c F_{cr} = 32.95$ ksi

$\phi_c P_n = (32.95)(2)(14.7) = 968.7\ k > 925\ k$ ok

(2)

PROB #8-2

Elastic calculations



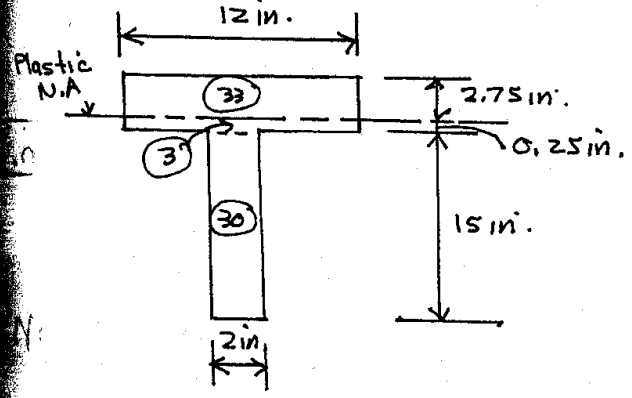
$A = (12)(3) + (15)(2) = 66 \text{ in.}^2$

$\bar{y} = \dfrac{(36)(1.5) + (30)(10.5)}{66} = 5.59 \text{ in.}$

$I_x = \left(\frac{1}{3}\right)(12)(5.59)^3 - \left(\frac{1}{3}\right)(10)(2.59)^3 + \left(\frac{1}{3}\right)(2)(12.41)^3 = 1914.96 \text{ in.}^4$

$S_x = \dfrac{1914.96}{12.41} = \boxed{154.31 \text{ in.}^3}$

Plastic calculations



$Z_x = (33)\left(\frac{2.75}{2}\right) + (3)\left(\frac{0.25}{2}\right) + (30)\left(0.25 + \frac{15}{2}\right) = \boxed{278.2 \text{ in.}^3}$

Shape factor $= \dfrac{278.2}{154.31} = \boxed{1.80}$

✓ gCM ≡

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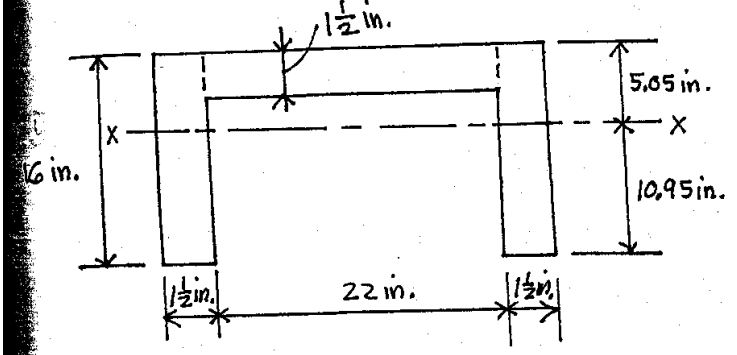
PROB # 8-4

Elastic calculations



$A = (2)(16)(1\tfrac{1}{2}) + (22)(1\tfrac{1}{2})$

$= 81 \text{ in.}^2$

$\bar{y} = \dfrac{(2)(16)(1\frac{1}{2})(8) + (22)(1\frac{1}{2})(0.75)}{81}$

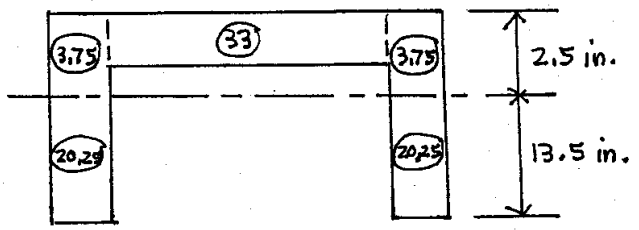
$= 5.05 \text{ in.}$

$I_x = (2)(\tfrac{1}{3})(1.5)(5.05^3 + 10.95^3) + (\tfrac{1}{3})(22)(5.05^3 - 3.55^3)$

$= 2058 \text{ in.}^4$

$S_x = \dfrac{2058}{10.95} = \boxed{187.95 \text{ in.}^3}$

Plastic analysis



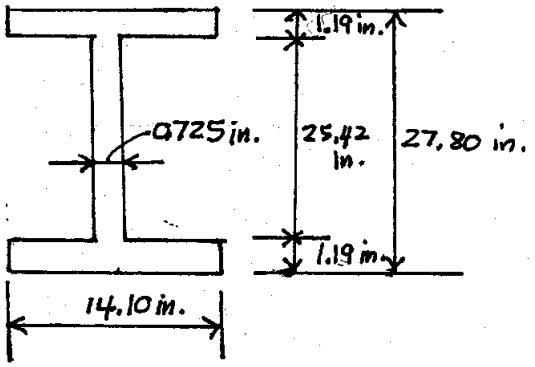
$Z_x = (2)(20.25)(\tfrac{13.5}{2}) + (2)(3.75)(\tfrac{2.5}{2}) + (33)(1.75) = \boxed{340.5 \text{ in.}^3}$

Shape factor $= \dfrac{340.5}{187.95} = \boxed{1.81}$

✓ ycm ☺

PROB # 8-11

Using a W27X178



Elastic calculations

$I_x = \left(\frac{1}{12}\right)(14.10)(27.80)^3 - \left(\frac{1}{12}\right)(14.10-0.725)(25.42)^3 = 6937 \text{ in.}^4$

(Manual $I_x = 7020 \text{ in.}^4$)

$S_x = \frac{6937}{13.90} = \boxed{499 \text{ in.}^3}$ (Manual gives 505 in.^{3})

Plastic calculations

$Z_x = (2)(14.10)(13.90)\left(\frac{13.90}{2}\right) - (2)(14.10-0.725)(12.71)\left(\frac{12.71}{2}\right)$

$= \boxed{563.6 \text{ in.}^3}$ (Manual gives 570 in.

Shape factor $= \frac{563.6}{499} = \boxed{1.13}$

(using Manual values $= \frac{570}{505} = 1.13$)

✓ JCMC

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